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CURRENT ACTIVITIES

ATLANTIC PROVINCES

Dutch Elm Disease Firmly Established in New Brunswick.—In November, 1957, the first tree in New Brunswick known to be infected with *Ceratocystis ulmi* (Buism.) C. Moreau, the causal fungus of Dutch elm disease, was discovered at Woodstock, Carleton County. This tree was cut and sprayed with DDT in the spring of 1958 to prevent the emergence of the bark beetles that carry the disease. However, an intensive survey conducted by the Forest Biology and Plant Protection Divisions during 1958 showed that the disease was firmly established in the area. In addition, a number of diseased trees were found in Victoria and York Counties. While no attempt was made to locate all infected trees in the Woodstock area, the causal fungus was obtained in cultures from 110 trees. Of these, 92 were in the Woodstock area, 15 in Victoria County, and 3 in York County.

The examination of a limited number of diseased trees in the Woodstock area showed that large numbers of the native elm bark beetle, *Hylurgopinus rufipes* (Eichh.), were present. This is the chief vector in Quebec and New Brunswick. The smaller European elm bark beetle, *Scolytus multistriatus* (Marsh.) an important vector in the United States and southwestern Ontario, was not found.

In an attempt to check the southward spread of the disease into areas where elms are the most important shade trees, the three infected trees found in York County were cut and sprayed. One of these trees occurred at Kingsclear, 14 miles from Fredericton, "The City of Stately Elms".—A. G. Davidson, Forest Biology Division, C. C. Smith, Forest Biology Division and A. E. McCollom, Plant Protection Division.

Soil Temperatures and Birch Decline.—In a previous study (Redmond, D. R. 1955. Studies in forest pathology. XV. Rootlets, mycorrhiza, and soil temperatures in relation to birch dieback. Can. J. Bot. 33: 595-627) of heating soil under a stand of yellow birch by means of electric cables, it was shown that an increase of 2°C. in the average temperature of the soil above that occurring during the growing season of 1953 caused rootlet mortality in yellow birch to increase from a normal value of about 6 per cent to about 60 per cent. However, only a small proportion of the rootlets of any tree was damaged by this treatment, and no decline in the vigour of foliage or twigs could be observed.

In 1954 an attempt was made to relate symptoms of decline in the foliage of an apparently healthy and large yellow birch tree to increased temperature in the soil containing a considerable portion of its root system. The average increment in the soil temperature during the season was maintained at 2.6°C. Rootlet mortality in the heated area was about 75 per cent and amounted to about 20 per cent of all the rootlets of the tree. There were indications that as a result the new twigs were thinner and bore smaller foliage which was slightly curled and chlorotic. Some twigs were defoliated prematurely and staminate flowers were almost lacking. None of the symptoms were readily apparent.

During 1956 and 1957 heat was applied to an area of soil containing all or most of the root systems of five yellow birch and three white birch trees. These trees were 8 to 10 feet tall. The temperature was maintained at an average of 2.8 and 3.5°C. above that occurring in adjacent areas of soil throughout the summers of 1956 and 1957, respectively. Moisture content of the heated soil was determined periodically and at no time was it found to be below the wilting point.

No symptoms of decline in foliage appeared during 1956. About 40 per cent of the twigs on the yellow birch failed to elongate during 1957, although the buds had burst normally during the spring. Although the foliage on one or more branches of each of the yellow birch trees had become chlorotic by late August, 1957, and fell prematurely, no twigs were dead. There were no symptoms of decline in white birch. Examination of the root systems of these trees at the end of 1957 showed that over 75 per cent of the rootlets of yellow birch and between 30 and 50 per cent of those of white birch were dead.—D. R. Redmond.

ONTARIO

Host Tree Preferences of Adults of Neodiprion lecontei (Fitch).—Host tree preferences which differ markedly from those recorded for this species by Benjamin (U.S. Dept. Agr. Tech. Bul. 1118. 1955) were observed in an outbreak in the Kirkwood Forest Management Unit (60 miles east of Sault Ste. Marie, Ont.) in 1955 and 1956. In this area only red pine, *Pinus resinosa* Ait., was attacked, and only one generation of sawflies occurred per year. Adults were first observed ovipositing on June 10, 1955 and on June 14, 1956. They continued doing so for approximately one month in both years.

Site preferences of ovipositing females were studied in a plantation in which open-grown red pines, and red pines shaded by an overstory of trembling aspen, *Populus tremuloides* Michx., were present. During the oviposition period, daily examinations were made on 66 open-grown and 34 shaded trees in 1955 and 55 open-grown and 45 shaded trees in 1956.

A 2 x 2 contingency test of trees on which eggs were laid against those on which no oviposition occurred indicated a highly significant preference for open-grown trees in both years (chi^2=17.7). Also, it was noted in 1955 that previous years' defoliation was largely confined to open-grown trees, and a further contingency test showed that this preference for open-grown trees existed in previous years (chi^2=13.2).

Testing the open-grown trees only, it was found that eggs were not randomly distributed on these, and that all the discrepancies from randomness were in the direction of contagion. When previous defoliation on the open-grown trees was categorized as heavy (40-50 per cent defoliated), medium (10-35 per cent), light (less than 10 per cent), and none, and the number of egg clusters per tree plotted against these categories, a straight-line relation between increasing defoliation and increasing number of egg clusters per tree was found.

From these tests one can conclude not only that open-grown trees were preferred over shaded trees for oviposition, but that among open-grown trees, certain of them had characteristics that rendered them more susceptible to attack than others, and that this susceptibility remained from year to year. These results differ sharply from those obtained by Benjamin (loc. cit.), who found that when shaded and open-grown trees were present in the same plantation, the former were preferred.—K. J. Griffiths.

PRAIRIE PROVINCES

Weather Injury to Trees in Manitoba.—Manitoba recently experienced some rather unusual weather conditions. These were: Low precipitation, with about half of normal from March 1, 1957, to May 30, 1958; mild weather during the last week of March, 1958 (59° F. at Winnipeg on March 29); and a severe frost on April 29 (7.4° F. at Winnipeg). The effect on trees was very striking, causing "winter drying" and killing of buds.

The "winter drying" evidently was caused by the warm temperatures of late March, possibly aggravated by high winds and drought. These conditions presumably resulted in the rapid browning of conifers during the first two weeks of May. Conifers that showed most severe browning were balsam fir, white spruce, jack pine, and cedar. Trees of all ages from seedlings to mature trees were affected to varying degrees. Mortality was largely confined to individual trees or small patches of young balsam fir. Browning was especially noticeable in the Interlake area and the south-eastern part of Manitoba.

At the time of the severe frost on April 29, buds of many tree species were well advanced, with the green tips of the foliage beginning to show in some cases. Most of the early buds were killed by this frost. The species most seriously affected was aspen. Aspen stands growing in some very early sites showed nearly complete bud-killing, and in exceptional cases these had failed to foliate by June 30. Adjacent stands often showed normal foliage or widely

scattered leaf clusters, with the leaves abnormally large and atypical in shape. In the case of white birch, bud-killing was less severe and recovery was characterized by abnormally large leaves on the inner section of the branches and very small leaves on the outer 12 to 18 inches of the branches. In addition to aspen, bud-killing was noted on green ash, white spruce, and balsam fir The young needles of tamarack were also killed. Frost injury occurred in southern and south-eastern Manitoba, the Interlake area, and extended into eastern Saskatchewan.

"Winter-drying" and bud-killing undoubtedly had a considerable effect on reducing populations of forest insects, especially the spruce budworm and large aspen tortrix.—W. A. Reeks.

Winter Damage in a Saskatchewan Nursery.—The snow layer was very thin and temperature very low at Big River nursery during the winter 1956-57. This was related to unusual damage to seedlings of white spruce (*Picea glauca* (Moench) Voss), jack pine (*Pinus banksiana* Lamb.), lodgepole pine (*P. contorta* var. *latifolia* Engelm.) and red pine (*P. resinosa* Ait.).

Spruce transplants were widely damaged by winter drying, which caused a conspicuous rusty appearance after the snow had melted. In exposed transplants the lower needles were yellowish-green and the upper needles rusty-red. When broken and rubbed, the rusty needles felt unusually dry. The injury was common above a level of about 4 inches, which also was the approximate depth of the snow during most of the winter. Only the shortest transplants in some low lying areas, where snow tends to accumulate, had fully retained their normal green colour. The buds were not killed, and in spite of the alarming appearance and great loss of needles, the transplants recovered and grew well during the summer. Similar but less extensive damage occurred in most 3-0 seedling stands. Only a few of the 2-0 seedlings were damaged, presumably because most of them did not reach above the snow level. The damage to pines could not be seen in early spring because of the normally brownish winter colour of the needles. Examination of the seedbeds in July revealed that the uppermost needles or the tips of these had been killed in many tall pine seedlings.

In the seedbeds of spruce and pines a few 2-0 seedlings were unable to recover at all, and others exhibited dead tips. In the latter, one or more new leaders developed from the lower part of the stem. The dead tips were more common in lodgepole pine and red pine than in spruce and jack pine. This may be because these two pine species are not native, but are introduced from somewhat lower latitudes and more favourable climate than at this nursery.

No natural snow mould damage occurred, which is unusual in this nursery. Even in beds that were artificially inoculated with various low temperature fungi this disease did not develop. The inoculations were made in October in snow-covered spruce beds, using species of Basidiomycetes, *Pestalotia, Fusarium, Epicoccum, Botrytis, Phoma, Alternaria, Cylindrocarpon, Pythium,* and others. None of these fungi appeared capable of growing in snow with the severe weather of that winter.

A few individual spruce transplants showed symptoms distinct from both winter drying and snow mould damage. All the needles were bright red and the seedlings were dead soon after the snow had melted. The cause of this injury could not be determined.—O. Vaartaja.

BRITISH COLUMBIA

Ambrosia Beetle Brood Productivity.—Preliminary studies of the brood productivity of the ambrosia beetle, *Trypodendron lineatum* (Oliv.), were made in the Cowichan Lake area during 1956. The female of this species deposits eggs singly in distinct niches cut in the gallery wall and as the larva grows it enlarges the niche until it becomes a pupa. It is possible, therefore, by carefully excavating a gallery with hammer and chisel after the brood has developed, to count the number of eggs deposited and the number which reached the pupal stage. The productivity of that gallery can then be estimated, although mortality during the post-pupal feeding period is not accounted for.

The objective of thse preliminary studies was to determine brood productivity in different parts of various logs. The basic sample unit consisted of ten galleries, all taken within a small area of log surface. Precise times of beetle attacks for each gallery were not known, but it is probable that most were started within a period of less than three weeks. For this reason it is assumed that all broods in a given sample were subject to essentially the same physical and chemical environment.

Most of the 300 galleries examined were in Douglas fir logs lying among standing trees of a mixed 200-250 year old western hemlock-Douglas fir forest. These logs were from slow-growing trees with shallow sapwood (¾-1¼ inches), felled the previous December. Attack densities ranged from 25 to 150 entrance holes per square foot of log surface, but a cursory examination of the data failed to reveal a relationship between density and brood productivity.

Samples were taken from each of four quadrants near the bases of four of these trees. One side of each log was more exposed to sunlight, due to the topography and the nearness of a clear-cut area to the northwest. Group comparisons between quadrants were made possible by pooling data for the four trees. Student's "t" test was used to measure the reliability of differences between these and other averages given in the accompanying table.

Host	Average Values				
	Basis: No. Galleries	Gallery Length cm.	No. Egg Niches	No. Pupal Niches	Per Cent Survival
Old-growth fir:					
Quadrants—					
Upper	40	7.3	10.3	5.6	52.7
Lower	40	9.7	12.0	7.4	60.6
Shaded side	40	8.3	10.5	6.0	56.4
Exposed side	40	8.1	8.8	3.9	41.2
All Quadrants-Means	—	8.4	10.4	5.7	52.7
Standard deviations	—	2.8	4.1	3.9	25.3
Spring Attack	40	8.3	11.0	6.2	56.0
Mid-season Attack	40	8.3	13.5	7.1	51.0
Second-growth fir:	20	9.7	24.4	16.3	62.3

Several results of the analysis of data on the galleries are worthy of note. First, egg galleries on the undersides of the logs were significantly longer than those in the top or side quadrants ($P < 1\%$). Significantly fewer egg niches were found in galleries on the exposed sides of the logs than on the undersides ($P < 1\%$) and the shaded sides ($P < 5\%$). The number of pupal niches in galleries on the exposed side was relatively low, and differed at the 5 per cent level in comparison with those in the upper quadrant, and at the 1 per cent level in comparison with those of the other two quadrants. Survivors in the upper galleries were fewer than in the tunnels on the undersurfaces ($P < 1\%$). Percentage survival based on individual pupal/egg niche values showed significantly lower values for the exposed side in comparison with the shaded side ($P < 5\%$) and the lower side ($P < 1\%$).

After the brood from the initial spring attack has developed, many old parent beetles of this species start a second brood in mid-season. A portion of a log was protected from the first attack by covering it with plastic sheeting in the spring, and then exposed to the re-attacking beetles in July. Thus brood data were obtained from the two attack periods from contiguous sections of the same tree. The slight differences shown for the two broods are not significant. The second attack gallery data, however, varied considerably more than those of the first attack. For example, the coefficient of variation of number of egg niches was 92 per cent for the second brood, compared with 46 per cent for the first brood, and 39 per cent for the quadrant analysis galleries. This suggests that the re-attacking population varied more in vigour than beetles of the first flight.

An additional 20 galleries selected at random were excavated in two small diameter logs from young Douglas fir (35-40 years) about 10 miles from the old-growth stand. These data are few, but they are sufficient to demonstrate that numbers of eggs and pupae and per cent survival in this material were significantly greater than corresponding values for the pooled quadrant data of the 160 galleries in logs from old trees. Dissimilarity between average gallery lengths of the two classes of host cannot be proved.

Within a given sample of galleries, egg production and survival varied considerably. As the galleries were constructed in essentially the same environment within the log this variability must be attributed primarily to differences between the insects themselves in their capacity for excavation and egg production. At the same time, it should be noted that the quadrant results show an environmental effect on all phases of productivity, while the results from the young-growth galleries suggest a host effect. The data indicate a relatively low brood productivity for *Trypodendron* in this area.—C. Gibson, J. Kinghorn, and J. Chapman.

Population Trends of Some Common Loopers (Geometridae) on Douglas Fir, 1949-1956, in the Okanagan-Shuswap Area.—A preliminary study was undertaken to determine the annual fluctuations in the populations of some common forest insects in the interior of British Columbia. Six loopers, Geometridae, on a single widespread host, Douglas fir, *Pseudotsuga taxifolia* (Poir.) Britton, were selected for the study: *Semiothisa granitata* Gn., *Melanolophia imitata* Wlk., *Nepytia canosaria* Wlk. (?), *Lambdina fiscellaria lugubrosa* (Hlst.), *Ectropis crepuscularia* (Schiff.), and *Nematocampa filamentaria* Gn. The data on these species were taken from the files of the Forest Insect Survey, Forest Biology

Laboratory, Vernon, B.C. Only data from the Okanagan-Shuswap area in the Kamloops Forest District have been analysed for this paper.

Most of the data were obtained from standard beating collections taken by brushing and lightly beating with a 10-ft. pole, those branches of the sample tree that overhang a 7 by 9 foot mat placed on the ground. A standard sample is made up of three tree beatings in one locality. Data from 1,395 collections taken from Douglas-fir trees from 1949 to 1956 have been examined. The number of collections taken annually from Douglas fir ranged from 56 to 221 with an average of 174. This study was based on the presence or absence of the insects in the collections; no attempt was made to use the data on numbers of insects per collection.

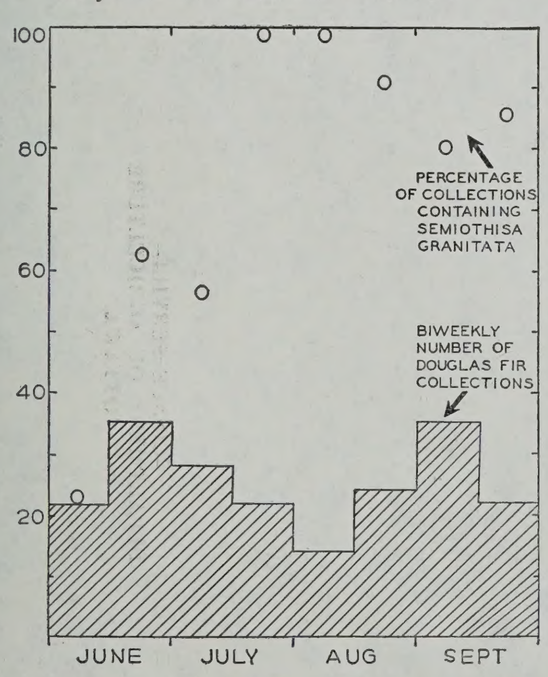
The larval feeding period for each of the six species and the bi-weekly number of collections from Douglas fir were determined for each year; the percentage of collections from Douglas fir containing each of the insect species under consideration was calculated on a bi-weekly basis. Graph 1 shows the actual number of Douglas-fir collections per 2-week period during the larval feeding instars of *Semiothisa granitata*. The 1949 data were chosen as a typical example. The graph further shows that the bi-weekly total number of collections from Douglas fir varied greatly; the range was 14 to 35 collections. This variation is a weakness of the data.

The abundance of the loopers as based on percentage of collections containing the species during the larval feeding period differed greatly. There appear to be three classes, actually three pairs of curves, for the years 1949 to 1956 for the six species studied:

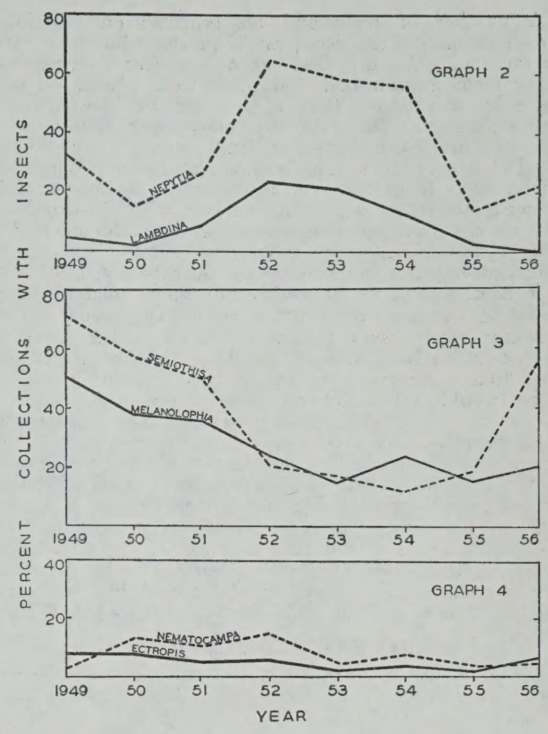
Class 1. *Lambdina fiscellaria* and *Nepytia canosaria* represent this category; curves for their population trends are shown in Graph 2. Both species were numerous some years and relatively scarce other years. The population fluctuations show a wide range over the years; in other parts of the Interior these two species have been sufficiently numerous to cause noticeable defoliation and tree mortality in localized areas. The curve shows an inverse relationship to that of *Semiothisa granitata* and *Melanolophia imitata*. These species overwinter as pupae in the duff whereas *Nepytia* and *Lambdina* overwinter in the egg stage on the host tree.

Class 2. *Semiothisa granitata* and *Melanolophia imitata* represent this class; curves for their population trends are shown in Graph 3. The two species in this class were numerous and widespread; they have not been known to be sufficiently numerous to cause noteworthy defoliation.

Class 3. *Nematocampa filamentaria* and *Ectropis crepuscularia* represent this class; curves for their population trends are shown in Graph 4. The two species in this class were not numerous but were widespread. The fluctuations in abundance show a narrow range over the years.—W. E. Bitz and D. A. Ross.



Graph 1. Number of beating collections from Douglas fir for each two week period, June to September inclusive, 1949, and the percentage of these collections that contained *Semiothisa granitata*, Okanagan-Shuswap area.



Graphs 2, 3 and 4. Annual percentage of beating collections from Douglas fir trees taken during the larval feeding period that contained *Lambdina fiscellaria, Nepytia canosaria; Semiothisa granitata, Melanolophia imitata; Nematocampa filamentaria, Ectropis crepuscularia.* 1949 to 1956, Okanagan-Shuswap area.

Response of Trypodendron to Forest Litter.—The ambrosia beetle, *Trypodendron lineatum* (Oliv.), overwinters in forest litter (duff). Young beetles enter it as soon as they leave the logs in which they have developed. Old or parent adults enter after they have ceased brood production for the season. In spring both groups of beetles leave their overwintering quarters to make an attack flight. Because a marked change in life activity occurs when beetles enter or leave litter one might expect positive and consistent responses to it.

In 1956, trays of beetle-free moistened litter were placed under a pile of freshly attacked logs. By July 25 gallery exacavations showed that almost all the brood had left the logs, but not a single beetle could be found in litter into which 266 individuals were estimated to have dropped, on the basis of water-pan traps beneath the logs. Some beetles were found in dry undisturbed litter nearby, however, and usually some can be found under attacked logs late in the season.

On July 23 five groups, each consisting of 100 recently emerged adults, were placed on small plots of natural forest ground cover, including moss and grass, deciduous leaf debris and conifer litter, and observed for ten minutes after release. From 1 to 6 individuals per groups flew away during that time but most soon started to burrow. On the driest location (thin moss and grass, sun-lit at the time), however, between 20 and 30 beetles were still walking about at the surface after ten minutes. On July 30 all material above the mineral soil in the plots was examined. Two plots, including the driest, yielded no beetles but the others had 3, 8, and 41, the last two figures, respectively, representing a plot well moistened 20 minutes after release of the beetles and a well-shaded, damp, stream bed location.

On July 31, a similar test was made with 350 beetles in 7 groups, placed on natural litter, dry to the touch, in a second-growth Douglas fir stand. Recovery after two days was 0 and 1 for two plots in thinned, and 12, 16, 20, 26 and 33 for plots in unthinned portions of the stand. A third test, with 300 beetles in 6 groups, was started Aug. 3 just after a rain. Beetles were placed on the ground at various points in the same area used for the July 23 tests. Within ten minutes of release, flight attempts were made by only 6 beetles, all at the most exposed location. Recoveries on Aug. 22 were 0 for the plot there and 7, 7, 8, 14, and 15 for the other plots.

These tests indicate that beetles which have recently emerged from brood logs have a strong tendency to enter litter but that they may later leave a given location, particularly when it is quite dry. They entered and remained in litter more readily in shaded than in exposed locations. Moisture alone did not keep beetles from leaving, however.

A number of tests and observations on reactions of *Trypodendron* to litter were made in the laboratory also, in 1956 and 1957. When beetles taken just after emergence from logs or from autumn-collected litter were placed on a bare surface by a window, they almost always crawled or flew towards the light. On moist absorbent paper, thinly scattered litter, or thin cloth covering fresh moist litter they still walked or flew to the window without hesitation. When placed on deep moist litter, however, most started to burrow and the burrowing tendency was still marked with air-dried litter. Moist or dry peat moss or coarse sawdust also elicited burrowing responses, although more beetles left these materials without attempting to enter them. Apparently, at this stage of life beetles tend to fly readily but the tendency is greatly reduced by contact with litter or something similar.

Many other tests involved beetles taken from litter collected in early spring or caught in spring attack flight. It was found, surprisingly, that at this stage of life also the beetles would often burrow into litter whether in the laboratory or out of doors in fair weather. Furthermore, when the same individuals were tested consecutively three or more times, a number would fly each time but many would burrow into the litter repeatedly and still others would alternate in their response between flying and burrowing.

These preliminary tests and observations did not reveal the expected positive responses to litter. Factors both within the beetles and external to them appear to be involved in their reactions to it. Further study will be necessary to clarify this aspect of *Trypodendron* behaviour.—J. A. Chapman.

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